

UNIVERSITY OF BOLTON

SCHOOL OF ENGINEERING

**BSC (HONS) ENVIRONMENTAL SCIENCE AND
MANAGEMENT (ENVIRONMENTAL PRACTITIONER
DEGREE APPRENTICESHIP)**

SEMESTER 2 2022/23

**INTRODUCTION TO ENVIRONMENTAL SCIENCE
AND ENGINEERING
MODULE NO: CIE4014**

Date: Friday 12th May 2023

Time:

10:00 – 12:00

INSTRUCTIONS TO CANDIDATES:

This examination is structured in three parts. Part I contains multiple choices questions (40% of the total mark); Part II contains short answer questions (30% of the total mark); Part III is a long-answer question that will require a piece of writing (or essay) for discussion (30% of the total mark).

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Part I. Multiple choices questions (total 40 marks)

Please tick the correct answer before the heading number. Please note that each question has only one correct answer. You will get no mark if you tick more than one answer in each question. Each question is worth 2 marks.

Q1.1: The atomic mass of carbon (C) is 12 Da, and that of oxygen (O) is 16 Da. Two moles of carbon dioxide (CO₂) equal how many grams?

- [1] 28
- [2] 88
- [3] 44
- [4] 56

Q1.2 Which of the following aspects is NOT involved in a functional ecosystem?

- [1] Volcanic eruption;
- [2] Nitrogen cycle;
- [3] Carbon cycle;
- [4] Food chain.

Q1.3 In the presence of sunlight plants can conduct a photosynthesis process in which plants will release which of the following gases into the atmosphere?

- [1] Carbon dioxide;
- [2] Water;
- [3] Nitrogen;
- [4] Oxygen.

Q1.4 Greenhouse gases can absorb solar radiation in the infrared (IR) region. In comparison with the solar radiation in other wavelength regions, which of the following statements is true?

- [1] The wavelength of IR is larger than that of radio waves;
- [2] The wavelength of IR is larger than that of microwaves;
- [3] The wavelength of IR is shorter than that visible light;
- [4] None of the above answers is correct.

Q1.5 Which of the following statements is correct?

- [1] The bonding nature of the salt (NaCl) is covalent;
- [2] The bonding nature of carbon dioxide (CO₂) is ionic;
- [3] The bonding nature of methane (CH₄) is ionic;
- [4] The bonding nature of oxygen (O₂) is covalent.

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Q1.6 Which of the following sequence is true in terms of food chain in an ecosystem?

- [1] Plants → Herbivores → Carnivores;
- [2] Plants → Carnivores → Herbivores;
- [3] Herbivores → Carnivores → Plants;
- [4] Carnivores → Herbivores → Plants.

Q1.7 Global warming has been driven by emissions of greenhouse gases from human activities. Which of the following pairs of gases has been considered as NOT being greenhouse gases?

- [1] Carbon dioxide (CO₂) and Methane (CH₄);
- [2] Oxygen (O₂) and Nitrogen (N₂);
- [3] Water vapour (H₂O) and nitrous oxide (N₂O);
- [4] Ozone (O₃) and sulphur dioxide (SO₂).

Q1.8 Methane (CH₄) is a chemical compound which has been considered as one of the main greenhouse gases. Which of the following describes the molecular structure of methane?

- [1] Cubic structure with carbon atom sitting in the structural centre;
- [2] Triangle structure with carbon atom sitting in the structural centre;
- [3] Tetragonal structure with carbon atom sitting in the structural centre;
- [4] Tetragonal structure with carbon atom sitting on one of the structural corners.

Q1.9 Carbon dioxide (CO₂) is one of most important greenhouse gases. However, it cannot be directly released into the atmosphere from which of the following processes?

- [1] Freezing water;
- [2] Combustion of petrol;
- [3] Volcanic eruption;
- [4] Burning wood.

Q1.10 Freon is a type of halogenated hydrocarbons. When Freon is released into atmosphere, which of the constituent substances in the air can be damaged?

- [1] Oxygen near the ground;
- [2] Nitrogen in the troposphere;
- [3] Ozone in the stratosphere;
- [4] None of the above substances.

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Q1.11 Which of the followings may be considered as an environmental effect of climate change?

- [1] Deforestation;
- [2] Droughts and heatwaves;
- [3] Air pollution by household waste;
- [4] Water pollution by heavy metals;

Q1.12 Which of the following measures would NOT help reduce climate change effects?

- [1] Corporate actions for reducing greenhouse gas emissions at global level;
- [2] Increase solar and wind power;
- [3] Improve energy efficiency in buildings;
- [4] Produce more electronic devices by robots for daily use.

Q1.13 When a material undergoes combustion, the process may generate smoke that contaminates the environment. Which of the following statements best describes the composition of smoke?

- [1] Smoke is a collection of gaseous products of combustion;
- [2] Smoke is a collection of airborne solid particles of combustion;
- [3] Smoke is a collection of airborne liquid particles from combustion;
- [4] Smoke is a collection of airborne solid and liquid particles and gaseous products of combustion.

Q1.14 Acidification of lakes and rivers can be caused by which of the following substances?

- [1] Black carbon soot;
- [2] Dust particles;
- [3] Nitrogen gas;
- [4] None of above materials.

Q1.15 Assume a contaminated air contains SO₂ in the concentration of 25.8 µg/m³, which of the following describes the same concentration as the above?

- [1] 0.00258 mg/m³;
- [2] 0.0000258 g/m³;
- [3] 2580 ng/m³;
- [4] 0.00000258 kg/m³.

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Q1.16 Hazardous substances transported on roadways must carry a Department of Transportation (DOT) warning label on the package, and different types of hazardous substances are indicated by different colour coding on the label. Which of the following colour code represents poisonous or infectious substances?

- [1] Red;
- [2] Orange;
- [3] Black;
- [4] White.

Q1.17 Water can dissolve many inorganic salt pollutants and hydrophilic organic pollutants mainly because of which of the following reasons?

- [1] Water has high boiling temperature;
- [2] Water has high specific heat capacity;
- [3] Water is a highly polar molecule;
- [4] The bond energy between oxygen and hydrogen in water is high.

Q1.18 If sulphur dioxide (SO_2) pollutant is dissolved into pure water, the pH value of this water will be changed. Which of the following statements is correct?

- [1] The pH will be higher than 7;
- [2] The pH will be higher than 9;
- [3] The pH will be lower than 7;
- [4] The pH will be 7.

Q1.19 Dissolved oxygen gas (O_2) in lakes could be very necessary to many fishes and aquatic organisms. Which of the following statements on dissolved oxygen is true?

- [1] Increase of the water temperature would lead to more amount of dissolved oxygen;
- [2] With the increase of water depth, the amount of dissolved oxygen will increase;
- [3] The increase of the water depth will decrease the amount of dissolved oxygen;
- [4] Water temperature and depth have no effect on the amount of dissolved oxygen.

Q1.20 Which of the following techniques may be considered as main environmental impact assessment (EIA) techniques used in scoping?

- [1] Baseline studies, checklists, review, and report;
- [2] Baseline studies, checklists, matrices, and network diagrams;
- [3] Checklists, monitoring, review and report;
- [4] Checklist, matrices, network diagrams, and report.

END OF PART I

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Part II. Short answer questions (total 30 marks)

Please write a couple of sentences to answer each question, or each component point in that question.

Q2.1 Describe the following three terminologies used in the current course: (1) Environment; (2) Environmental Science; (3) Environmental Engineering. (6 marks)

Q2.2 Describe two major environmental effects of climate change, and two important mitigation measures. (8 marks)

Q2.3 Name two physical and two chemical items/or parameters that can be used to assess the water quality of a river or lake. (4 marks)

Q2.4 For each item/or parameter listed by you in Q2.3, describe its scientific meaning and significance for water quality assessment. (8 marks)

Q2.5 Describe the following two items frequently encountered in environmental science and engineering: (1) PM_{2.5}; (2) VOCs. (4 marks)

END OF PART II

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Part III. Long answer question (total 30 marks)

Q3. To meet the high energy demand in modern societies, various kinds of energies are harnessed or generated from nature. Among them, hydropower produces electricity from a water source, where mechanical energy is generated when flowing water spins rotors on a turbine. The process is determined by the release of the gravitational potential energy and kinetic energy stored in a body of water at a hydroelectric dam. This mechanical energy is then transformed into electrical energy as the turbine is connected to an electromagnetic generator.

Hydroelectric power stations produce significantly fewer greenhouse gas emissions than other electricity generation options, such as the combustion of fossil fuels. The cost of operation once the dams are built is relatively inexpensive and these facilities can operate at high efficiencies. However, the construction of the dams may be expensive, and it may also damage the local environment and result in habitat loss for aquatic species.

What do you think about hydropower? You are now asked to produce a piece of writing (or essay) by providing a *priori* qualitative discussion on the pros and cons in the development of hydropower from energy security and environment viewpoints. (circa 250-400 words are suggested in your answer, but this is not compulsory)

END OF QUESTIONS

END OF PAPER